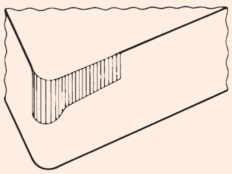
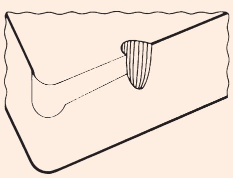
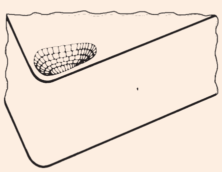
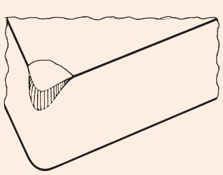
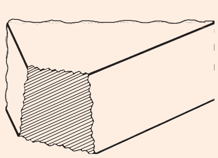
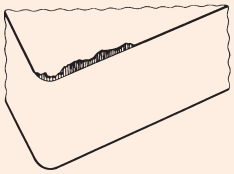
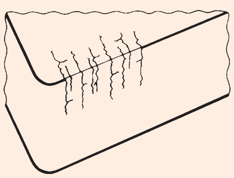
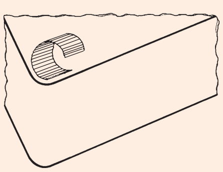
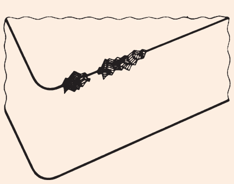
Problem	Cause	Remedy
Flank Wear 	■ General reason for end of tool life, characterized by an admissible amount of flank wear. Figures usually relate to a tool life of T=15 min.	❑ **Select more wear-resistant grade** ❑ **Reduce cutting speed**
Notch Wear 	■ Occurs locally in the area of the primary cutting edge where it contacts the workpiece surface. Caused by hard surface layers and work-hardened burrs, especially on stainless austenitic steels. Danger of breakage!.	❑ **Strengthen cutting edge** ❑ **Select smaller cutting edge angle (45°)** ❑ **Reduce feed**
Crater Wear 	■ Wear on the rake face, primarily characterized by crater depth. Not a tool-life criterion with modern coated hardmetal inserts and positive chipbreaker geometries.	❑ **Use coated hardmetal grades** ❑ **Select positve insert geometries** ❑ **Reduce cutting speed**
Plastic Deformation 	■ Caused by the overloading of the cutting edge combined with high machining temperatures. Danger of breakage!.	❑ **Reduce cutting speed** ❑ **Lower feed** ❑ **Use more wear resistant hardmetal grade**
Insert Breakage 	■ Insert breakage usually means damage to tool and workpiece. The causes are varied and also depend on machine and workpiece. This often originates in notches or other excessive types of wear.	❑ **Select tougher grade** ❑ **Use stronger insert with a larger corner radius** ❑ **Select chipbreaker geometry for heavier chip selections** ❑ **Reduce feed and possibly also depth of cut**

TROUBLESHOOTING

Problem	Cause	Remedy
Built-Up Edges 	■ Edge build-up occurs on the rake face as a result of work material welding together with the cutting material, especially when cutting difficult-to-machine material. From time to time the built up edge will break off and may cause damage to the cutting edge, also built-up edges produce poor surface finishes.	❑ **Increase cutting speed** ❑ **Use coated hardmetals or cermets** ❑ **Select positive cutting edge geometry** ❑ **Use cutting fluid**
Thermal Cracks 	■ Small cracks running across the cutting edge, caused by thermal shock loads in interrupted cutting operations, particularly in milling. Danger of breakage!.	❑ **Use grade with greater resistance to thermal shock** ❑ **Check use of cutting fluid; generally, cutting fluid should not be used for milling, except with special grades for wet milling (eg TN450), Aluminum and titanium alloys and high temperature materials** ❑ **Use compressed air to remove chips in slot milling**
Chip Control 	■ Effective chip control is essential for trouble-free operation. Key factors are work material, feed and depth of cut. Too short of a chip results in vibrations and cutting edge overload. Danger of breakage!	❑ **Avoid small depths of cut below 1X radius, except in finishing** ❑ **If chips too long: select chipbreaker geometry for smaller chip sections or increase feed** ❑ **If chips too short: select chipbreaker geometry for large chip sections or reduce feed.** ❑ **When form turning shoulders check sequence of operations**
Edge Chipping 	■ Minor chipping along the cutting edge, usually accompanied by flank wear and therefore not always indentifiable. Danger of breakage! Edge chipping outside the cutting area is the result of chip impact due to unfavourable chip removal.	❑ **Select tougher grade** ❑ **Use insert with stronger cutting edge geometry** ❑ **Reduce feed when starting the cut** ***Damage due to chip impact*** ❑ **Vary feed** ❑ **Change chipbreaker geometry** ❑ **Change cutting edge angle**

TROUBLESHOOTING

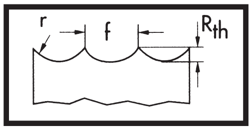
Problem	Cause	Remedy
Surface Finish	■ Surface roughness is a tool-life criterion often applied in finishing operations. It is affected by the configuration and condition of the cutting point, the cutting conditions and the rigidty of the machining setup.	❑ **Increase cutting speed** ❑ **Reduce feed** ❑ **Increase radius** ❑ **Use cermets where possible when cutting steel** ❑ **Avoid vibrations** ❑ **Use cutting fluid**
Chatter Marks	■ Chatter marks or surface damage due to unfavourable chip flow call for special measures.	❑ **Vary feed slightly** ❑ **Change cutting edge angle** ❑ **Select different chipbreaker geometry** ❑ **Check ridigity of tool and holding system**
Shape and Dimensional Accuracy	■ Shape and dimensional accuracy are affected by the condition of the overall machine-part-tool setup.	❑ **Select grade with adequate wear resistance** ❑ **Check cutting parameters, including machining allowance** ❑ **Check rigidity of tool and work holding systems** ❑ **Keep cutting forces low** ❑ **Avoid imbalance**
Vibrations, Instability	■ Vibrations in the workpiece usually occur with thin-walled parts and non-rigid setups. Unbalance and excessive cutting forces also cause problems.	❑ **Select larger cutting edge angle for the tool** ❑ **Use positive geometries** ❑ **Use smaller radii** ❑ **Change turning frequency** ❑ **Reduce chip section**
Burring	■ Burring cannot always be avoided when cutting steel workpieces. Chamfering operations should therefore be planned in where possible.	❑ **Select inserts with positive geometry** ❑ **Use sharpest possible cutting edges, eg. cermets** ❑ **Reduce cutting edge angle** ❑ **Check sequence of operations**

Finishing

In finish turning exacting demands are placed on surface finish and part accuracy.

To determine approximately the surface finish to be expected in turning with feeds > .004", the following formula for theoretical roughness height R_{th} can be used:

$$R_{th} \simeq \frac{125000 \times f^2}{r} \; [\mu in]$$



Radius	Theoretical roughness height Rth for feed f:					
	.004	**.005**	**.006**	**.008**	**.010**	**.013**
.016	125	200	300	500	800	---
.031	63	100	150	250	400	700
.047	---	63	100	175	250	450
.063	---	---	75	125	200	350

If the theoretical roughness height R_{th} is assumed to be roughly equal to Rz, the ten-point height (ISO), the roughness average Ra can be inferred, which however does not show a fixed relationship to Rz. A conversion ratio of Rz : Ra $\simeq$ 4 : 1 is generally appropriate.

Approximate reference values for the ratio Rz to Ra

Rz µin	63	100	160	250	400	640	1000
Ra µin	16	24	40	63	100	160	250

Note:

Good surfaces are achieved with:

- higher cutting speeds
- inserts with sharp cutting edges
- positive rake angles and chipbreaker geometries
- use of cermets
- rigid machining setups
- use of easily machinable work materials
- use of cutting fluid

Surface characteristics in the inch system (µin)

AA - arithmetic average ≙ Ra

CLA - centreline average ≙ Ra

RMS - root mean square ≙ 1.1 x AA

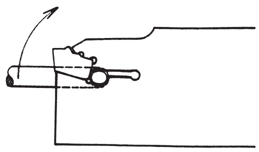
1µin = 0.025 µm

1µm = 40 µin

TROUBLESHOOTING

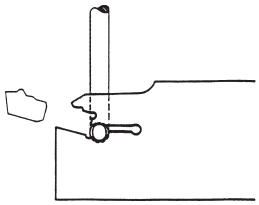
POINTERS ON MOUNTING FOR GROOVING OPERATIONS

ProGroove Single-edge grooving system

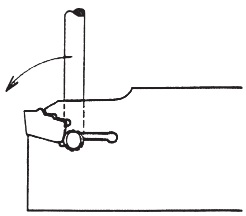


To change the cutting insert the wrench is inserted into the blade recess.

By turning through 90° the blade mouth is opened.



In this position the wrench is self-locking, leaving both hands free for changing the cutting insert.

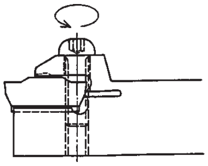


The cutting insert is pressed against the rear seat in the blade mouth, releasing the wrench. The insert is accurately positioned and securely clamped.

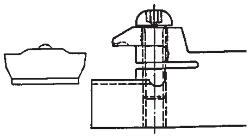
Assembly key:

For grooving widths of 2 - 5 mm   Order # 214.60.038
For grooving widths 6 and 8 mm   Order # 214.60.095

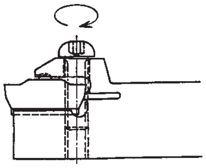
TwinGroove Double-edged grooving system



To change the insert the screw is loosened.



The upper clamping jaw springs open and releases the insert.
The insert is turned or changed



The insert is pressed into the insert pocket and the clamping screw tightened. The insert is accurately positioned and securely clamped.

Wrench:

For grooving widths of 2 - 5 mm   Order # 214.80.412
For grooving widths 6 and 8 mm   Order # 214.80.413